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(54) DRUG SOLUTION ADMINISTRATION DEVICE

VORRICHTUNG ZUR VERABREICHUNG VON ARZNEIMITTELLÖSUNGEN

DISPOSITIF D'ADMINISTRATION DE SOLUTION DE MÉDICAMENT

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(56) References cited:
WO-A1-2017/051619
US-A- 5 176 646
US-A- 5 236 416
WO-A1-2017/051619
US-A- 5 176 646
US-A- 5 236 416

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EP 3 925 647 B1

Description

Technical Field

[0001] The present invention relates to a liquid medicine administration device. <->

Background Art

[0002] Conventionally, a syringe pump type liquid medicine administration device has been known which administers a liquid medicine with which a liquid medicine container is filled into a living body by a pressing action of a plunger. The plunger can be configured to, for example, discharge the liquid medicine from the liquid medicine container when pushed into the liquid medicine container by a rotational driving force of a drive mechanism.

[0003] For example, Patent Literature 1 discloses a drive mechanism including a motor that generates a rotational driving force, a gear reduction mechanism that decreases the speed of rotation of the motor, and a feed screw that rotates in response to a torque from the gear reduction mechanism. The plunger is configured as a bearing of the feed screw, and is also configured to advance by rotation of the feed screw.

Citation List

Patent Literature

[0004] Patent Literature 1: JP 2015-181835 A

Summary of Invention

Technical Problem

[0005] However, in the liquid medicine administration device as described above, when blockage occurs in a liquid delivery path of the liquid medicine, a load is applied to a region on the upstream side of the blockage portion in the liquid delivery path by the plunger that is going to advance. As a result, the liquid medicine may leak out in the region upstream of the blockage portion in the liquid delivery path.

[0006] The present invention has been accomplished in view of the above problems, and an object thereof is to provide a liquid medicine administration device capable of preventing leakage of a liquid medicine when blockage occurs in a liquid delivery path of the liquid medicine.

Solution to Problem

Advantageous Effects of Invention

[0007] According to the liquid medicine administration device of the present invention, it is possible to prevent leakage of the liquid medicine when blockage occurs in a liquid delivery path of the liquid medicine.

Brief Description of Drawings

[0008]

Fig. 1 is a side view of a liquid medicine administration system according to one embodiment of the present invention.
Fig. 2 is a diagram schematically illustrating an example of use of the liquid medicine administration system illustrated in Fig. 1.
Fig. 3 is a schematic perspective view of a liquid medicine administration device constituting the liquid medicine administration system illustrated in Fig. 1.
Fig. 4 is an exploded perspective view of the liquid medicine administration device illustrated in Fig. 1.
Fig. 5 is a sectional view illustrating a canceling mechanism of the liquid medicine administration device illustrated in Fig. 1 and a periphery thereof.
Fig. 6A is a partially enlarged view of the liquid medicine administration device illustrated in Fig. 5.
Fig. 6B is a partially enlarged view of the liquid medicine administration device illustrated in Fig. 5.
Fig. 7A is a block diagram of a control system of a liquid medicine administration device according to a first modification.
Fig. 7B is a diagram schematically illustrating a rotation detector and the like according to the first modification.
Fig. 8 is a flowchart illustrating operation of a controller according to the first modification.
Fig. 9A is a partially enlarged sectional view illustrating a canceling mechanism and its periphery according to a second modification.
Fig. 9B is a partially enlarged sectional view illustrating the canceling mechanism and its periphery according to the second modification.
Fig. 9C is a partially enlarged sectional view illustrating the canceling mechanism and its periphery according to the second modification.
Fig. 10A is a partially enlarged sectional view illustrating a canceling mechanism and its periphery according to a third modification.
Fig. 10B is a partially enlarged sectional view illustrating the canceling mechanism and its periphery according to the third modification.
Fig. 10C is a partially enlarged sectional view illustrating the canceling mechanism and its periphery according to the third modification.

Description of Embodiments

[0009] Embodiments of the present invention will now be described with reference to the accompanying drawings. It should be noted that the following description is not intended to limit the technical scopes and meanings of terms set forth in the claims of the present application. Further, the dimensional ratios in the drawings are ex-

aggerated for convenience of description, and may differ from the actual ratios.

[0010] Figs. 1 to 4 are diagrams for describing a liquid medicine administration system 1, a liquid medicine administration device 100, and an administration instrument 200 according to the present embodiment. Figs. 5 to 6B are diagrams for describing a canceling mechanism 10 according to the present embodiment. An arrow X in each drawing indicates the "longitudinal direction (longitudinal direction of a liquid medicine container 110)" of the liquid medicine administration device 100, an arrow Y indicates the "width direction (depth direction)" of the liquid medicine administration device 100, and an arrow Z indicates the "height direction" of the liquid medicine administration device 100.

(Liquid medicine administration system)

[0011] The liquid medicine administration system 1 is used to administer a liquid medicine into a living body. As illustrated in Fig. 1, the liquid medicine administration system 1 includes the liquid medicine administration device 100 and the administration instrument 200.

[0012] As illustrated in Fig. 2, the liquid medicine administration device 100 and the administration instrument 200 are of a patch type that is attached to the body surface (skin) H of a user when used. The body part of the user to which the liquid medicine administration device 100 and the administration instrument 200 are attached is not particularly limited, and examples thereof include the abdomen and the thigh.

[0013] The liquid medicine administration system 1 can continuously administer a liquid medicine (not shown) with which the liquid medicine container 110 is filled included in the liquid medicine administration device 100 into a living body for relatively a long period of time (for example, several minutes to several hours) by a pressing action of a later-described plunger 130. Note that the liquid medicine administration system 1 may administer the liquid medicine at intervals into the living body.

(Liquid medicine administration device)

[0014] As illustrated in Figs. 3 to 5, the liquid medicine administration device 100 includes: a liquid medicine container 110 filled with a liquid medicine; a plunger 130 that expels the liquid medicine in the liquid medicine container 110; a housing 120 that holds the liquid medicine container 110 and the plunger 130; a drive mechanism 140 that advances the plunger 130 toward a tip of the liquid medicine container 110; a rotation restriction unit 150 that restricts rotation of the plunger 130; a detector 160 that detects a position of the plunger 130; and a controller 170 that controls operations of the drive mechanism 140 and the detector 160.

[0015] As illustrated in Figs. 3 and 4, the housing 120 has a box-shaped housing body 121 having a housing space formed therein, a chassis 122 that is housed in the housing space of the housing body 121 and can be fixed to the housing body 121, and a lid member 123 attached to the housing body 121 with the chassis 122 being housed in the housing space.

[0016] As illustrated in Figs. 3 and 4, a window 124 is formed in an upper surface 121a of the housing body 121 to allow the inside of the housing space to be visible from the outside of the housing 120. The window 124 is formed by providing a transparent or semitransparent portion on a part of the housing body 121.

[0017] As illustrated in Figs. 3 and 4, a base end opening 125 through which the chassis 122 is inserted into the housing space of the housing body 121 is formed in the base end of the housing body 121 in the longitudinal direction. The base end opening 125 of the housing body 121 is closed by the lid member 123 with the chassis 122 housed in the housing space.

[0018] A bottom surface 121b of the housing body 121 is provided with a sheet-shaped adhesive portion (not shown) that can adhere to the body surface H of the user. In an initial state before the liquid medicine administration device 100 is attached to the user, a releasable protective sheet is attached to an adhesive surface of the adhesive portion.

[0019] As illustrated in Fig. 4, the chassis 122 holds the liquid medicine container 110, the plunger 130, the drive mechanism 140, the rotation restriction unit 150, the detector 160, the controller 170, and a power supply unit 180.

[0020] The liquid medicine container 110 is a so-called prefilled type liquid medicine container. Therefore, the liquid medicine is charged in advance in a lumen 111 of the liquid medicine container 110. Examples of the liquid medicine include protein preparations, narcotic analgesics, and diuretics.

[0021] A sealing member (not shown) for preventing the liquid medicine from leaking is disposed at a tip opening (discharge port) formed at a tip 112 of the liquid medicine container 110. As illustrated in Fig. 3, the tip 112 of the liquid medicine container 110 is disposed to protrude from the housing body 121 to the outside. In addition, a mounting portion 115 that is to be connected to a tube 240 (see Fig. 1) described later is attached to the tip of the liquid medicine container 110 that protrudes from the housing body 121.

[0022] As illustrated in Fig. 4, the plunger 130 is inserted into the lumen 111 of the liquid medicine container 110. A gasket 135 slidable on an inner wall of the liquid medicine container 110 is disposed at a tip of the plunger 130. The outer periphery of the gasket 135 is in liquid-tight contact with the inner peripheral surface of the liquid medicine container 110, whereby the base end side of the gasket 135 is liquid-tightly sealed.

[0023] The plunger 130 is composed of a cylindrical member.

[0024] As illustrated in Fig. 5, the plunger 130 includes: a threaded portion 131 threadedly engaged with the feed

screw 143; and a plunger body 132 that advances with the rotation of the feed screw 143 and presses the gasket 135, while rotation with respect to the housing 120 (chassis 122) is being restricted by the rotation restriction unit 150. The plunger body 132 has a notch (not illustrated) on a surface facing the chassis 122, and holds the rotation restriction unit 150 to be described later.

[0025] The plunger 130 is provided with a canceling mechanism 10 that cancels the transmission of the pressing force from the plunger body 132 to the gasket 135 when receiving an axial reaction force equal to or greater than a preset pressing force from the gasket 135 during advancement with the rotation of the feed screw 143. The structure of the canceling mechanism 10 will be described later. In the present specification, the preset pressing force means a force required to expel the liquid medicine in the liquid medicine container 110 by the plunger body 132 pressing the gasket 135 in a case where blockage does not occur in the liquid delivery path of the liquid medicine. In addition, the axial reaction force means a drag force in a direction opposite to the direction in which the plunger body 132 is advanced in the longitudinal direction (X direction) to expel the liquid medicine in the liquid medicine container 110.

[0026] As illustrated in Fig. 4, the drive mechanism 140 includes: a motor 141 that receives a drive current from the power supply unit 180 to generate a rotational driving force; a speed reduction mechanism 142 including a gear that transmits the rotational driving force of the motor 141, and the like; and a feed screw 143 connected to the speed reduction mechanism 142.

[0027] The feed screw 143 converts the rotary motion transmitted from the speed reduction mechanism 142 into a linear motion, and advances the plunger 130 in the longitudinal direction.

[0028] In the present embodiment, the plunger 130 advances in the longitudinal direction with the rotation of the feed screw 143, while the rotation of the plunger 130 with respect to the housing 120 is being restricted by the rotation restriction unit 150. As the plunger 130 advances toward the tip of the liquid medicine container 110, the liquid medicine in the lumen 111 of the liquid medicine container 110 is expelled to the tube 240 (see Fig. 1).

[0029] The rotation restriction unit 150 restricts rotation of the plunger 130 with respect to the housing 120. As illustrated in Fig. 5, the rotation restriction unit 150 has a bottom surface 151 fixed to the housing 120 and a guide wall 152 that restricts the rotation of the plunger 130 to urge the plunger 130 to advance in the longitudinal direction. The guide wall 152 is erected in the height direction (Z direction) from the bottom surface 151. The guide wall 152 is disposed so as to protrude into the internal space of the plunger 130 from a notch (not illustrated) formed in a surface of the plunger 130 facing the chassis 122. In the present embodiment, the plunger 130 advances in the longitudinal direction with the rotation of the feed screw 143, while the rotation of the plunger 130 with respect to the housing 120 is being restricted by the rotation restriction unit 150. As the plunger 130 advances toward the tip of the liquid medicine container 110, the liquid medicine in the lumen 111 of the liquid medicine container 110 is expelled to the tube 240 (see Fig. 1).

[0030] As illustrated in Fig. 4, the detector 160 detects that the plunger 130 has advanced to a predetermined position L1. The predetermined position L1 can be set at any position in the longitudinal direction between a liquid delivery start position of the plunger 130 (the initial position of the plunger 130) to a liquid delivery end position (the position where the plunger 130 completely expels the liquid medicine in the liquid medicine container 110 to the tube 240).

[0031] The detector 160 can be constituted by, for example, a known contact sensor that transmits a predetermined electric signal when a detected portion (not illustrated) provided at the base end of the plunger 130 comes into contact therewith.

[0032] The controller 170 controls the operation of delivering the liquid medicine by the liquid medicine administration device 100 on the basis of the detection result by the detector 160. The controller 170 can be implemented by, for example, a known microcomputer (electronic circuit element) mounted with a CPU, a RAM, a ROM, and the like. The controller 170 centrally controls operation of the drive mechanism 140, the detector 160, and the power supply unit 180.

[0033] In the present embodiment, the controller 170 determines that a predetermined amount of the liquid medicine is not expelled from the liquid medicine container 110 when a predetermined time has elapsed after a command to start the operation is given to the drive mechanism 140, and the detector 160 does not detect that the plunger 130 has advanced to the predetermined position L1. For example, the predetermined time can be set to be longer than a time during which the plunger 130 can sufficiently move to the predetermined position L1 after the controller 170 gives a command to start the operation to the drive mechanism 140 in a case where blockage does not occur in the liquid delivery path of the liquid medicine. When determining that a predetermined amount of the liquid medicine is not expelled, the controller 170 stops the motor 141 and notifies the user of the current situation.

[0034] The power supply unit 180 can be composed of, for example, a known battery.

[0035] Next, the structure of the canceling mechanism 10 will be described with reference to Figs. 6A and 6B.

[0036] As illustrated in Fig. 6A, the canceling mechanism 10 includes a threaded portion 131. Therefore, the canceling mechanism 10 according to the present embodiment is threadedly engaged with the feed screw 143. When blockage occurs in the administration instrument 200 such as the tube 240 which is connectable to the liquid medicine administration device 100, the plunger 130 including the canceling mechanism 10 receives an

axial reaction force equal to or greater than a preset pressing force from the gasket 135 (see Fig. 5). Therefore, a larger axial reaction force than that when no blockage occurs acts on the canceling mechanism 10 (threaded portion 131) from the feed screw 143. Accordingly, when blockage occurs, the canceling mechanism 10 (threaded portion 131) is worn by the feed screw 143 that rotates by the drive mechanism 140 to advance the plunger body 132 in the longitudinal direction as illustrated in Fig. 6B.

[0037] When the canceling mechanism 10 is worn by the feed screw 143, the feed screw 143 turns free with respect to the threaded portion 131. Therefore, the feed screw 143 cannot transmit the rotational driving force of the motor 141 to the plunger body 132. Accordingly, when blockage occurs in the liquid delivery path of the liquid medicine, the canceling mechanism 10 can cancel the transmission of the pressing force from the plunger 130 including the plunger body 132 to the gasket 135.

[0038] Note that the material of the canceling mechanism 10 is not particularly limited, and a metal material or a resin material may be used as long as it is a soft material that is worn by the feed screw 143 when receiving an axial reaction force equal to or greater than a preset pressing force from the gasket 135.

[0039] The height of the screw thread of the canceling mechanism 10 may be lower than the height of the screw thread of the feed screw 143. With this configuration, the canceling mechanism 10 and the feed screw 143 are threadedly engaged with each other with their screw threads being lightly engaged with each other. Therefore, when the canceling mechanism 10 is worn by the feed screw 143, the screw thread of the feed screw 143 turns free earlier with respect to the threaded portion 131. Accordingly, the canceling mechanism 10 can further shorten the time from when the blockage occurs in the liquid delivery path of the liquid medicine until the transmission of the pressing force from the plunger body 132 to the gasket 135 is canceled.

(Administration instrument)

[0040] As illustrated in Figs. 1 and 2, the administration instrument 200 is connectable to the liquid medicine administration device 100.

[0041] The administration instrument 200 includes a connector 210, a needle tube 220 that is inserted into a living body, a puncture portion (cannula housing) 230, the tube 240, and a puncture assistance tool 250 that assists the puncture of the living body with the needle tube 220.

[0042] The connector 210 is connectable to the liquid medicine administration device 100 via a mounting portion 215 fixed to the connector 210. The mounting portion 215 can be connected to the liquid medicine administration device 100 by being externally fitted to the mounting portion 115 (see Fig. 4) which is provided at the tip 112 of the liquid medicine container 110 protruding to the outside of the housing 120.

[0043] The mounting portion 215 has inside a connecting needle (not shown) capable of piercing a sealing member (not shown) provided at the tip of the liquid medicine container 110.

[0044] The tube 240 communicates with the lumen 111 of the liquid medicine container 110 via the connecting needle.

[0045] A flow path (not shown) that connects the tube 240 and the lumen of the needle tube 220 is formed inside the puncture portion 230. The liquid medicine delivered to the puncture portion 230 via the tube 240 is administered into the living body through the flow path formed inside the puncture portion 230 and the needle tube 220.

[0046] When the liquid medicine is delivered to the user, the puncture assistance tool 250 is attached to the puncture portion 230. The puncture assistance tool 250 holds an introducer needle (inner needle) 251. The introducer needle 251 projects from the tip of the needle tube 220 when the puncture assistance tool 250 is attached to the puncture portion 230. The user can insert the needle tube 220 into the living body, while preventing the needle tube 220 from having any troubles such as breakage, by piercing the living body with the needle tube 220 with the introducer needle 251 inserted into the needle tube 220.

[0047] The puncture assistance tool 250 is removed from the puncture portion 230 after the needle tube 220 is inserted into the living body. The introducer needle 251 is withdrawn from the lumen of the needle tube 220 when the puncture assistance tool 250 is removed from the puncture portion 230.

[0048] After the needle tube 220 is inserted into the living body, the puncture assistance tool 250 is removed, and the puncture portion 230 is left on the body surface H of the user with the needle tube 220 left in the living body. In this state, the plunger 130 of the liquid medicine administration device 100 advances in the liquid medicine container 110, so that the liquid medicine with which the liquid medicine container 110 is filled is delivered to the lumen of the needle tube 220 through the tube 240 and the flow path of the puncture portion 230.

[0049] The introducer needle 251 can be, for example, a metal needle. Further, the needle tube 220 can be composed of, for example, a tubular member (cannula) made of resin.

[0050] Similar to the liquid medicine administration device 100, the administration instrument 200 is of a patch type that is attached to the body surface H of the user when used. The contact surface (bottom surface) 231 of the puncture portion 230 of the administration instrument 200 is provided with a sheet-shaped adhesive portion (not shown) that can adhere to the body surface. In an initial state before the administration instrument 200 is attached to the user, a releasable protective sheet is attached to an adhesive surface of the adhesive portion.

[0051] As described above, the liquid medicine administration device 100 according to the present embodiment includes: the liquid medicine container 110 filled

with a liquid medicine and having, at a tip, an opening through which the liquid medicine can be discharged; the gasket 135 for expelling the liquid medicine in the liquid medicine container 110, the gasket 135 being slidable on the inner wall of the liquid medicine container 110; the plunger 130 capable of pressing the gasket 135; the housing 120 that holds the liquid medicine container 110 and the plunger 130; the drive mechanism 140 that advances the plunger 130 toward the tip of the liquid medicine container 110; and the rotation restriction unit 150 that restricts the rotation of the plunger 130 with respect to the housing 120. The drive mechanism 140 includes the motor 141 and the feed screw 143 that rotates in response to the rotation of the motor 141. The plunger 130 includes: the threaded portion 131 threadedly engaged with the feed screw 143; and the plunger body 132 that advances with the rotation of the feed screw 143 and presses the gasket 135, while the rotation of the plunger 130 with respect to the housing 120 is being restricted by the rotation restriction unit 150. The plunger 130 is provided with the canceling mechanism 10 that cancels the transmission of the pressing force from the plunger body 132 to the gasket 135 when the plunger body 132 receives an axial reaction force equal to or greater than a preset pressing force from the gasket 135 during advancement with the rotation of the feed screw 143.

[0052] According to the liquid medicine administration device 100, when blockage occurs in the liquid delivery path of the liquid medicine, the plunger 130 receives an axial reaction force equal to or greater than the preset pressing force from the gasket 135. The canceling mechanism 10 cancels the transmission of the pressing force from the plunger body 132 to the gasket 135 when the plunger 130 receives an axial reaction force equal to or greater than a preset pressing force from the gasket 135. As a result, the gasket 135 cannot obtain torque for advancement toward the tip of the liquid medicine container 110. Thus, the configuration described above can prevent leakage of the liquid medicine when blockage occurs in the liquid delivery path of the liquid medicine.

[0053] In addition, the canceling mechanism 10 includes the threaded portion 131. When receiving an axial reaction force from the gasket 135, the threaded portion 131 is worn by the feed screw 143, and the feed screw 143 turns free with respect to the threaded portion 131. Therefore, the feed screw 143 cannot transmit the rotational driving force of the motor 141 to the plunger body 132. Accordingly, when blockage occurs in the liquid delivery path of the liquid medicine, the canceling mechanism 10 can cancel the transmission of the pressing force from the plunger 130 including the plunger body 132 to the gasket 135. Thus, the configuration described above can prevent leakage of the liquid medicine when blockage occurs in the liquid delivery path of the liquid medicine.

[0054] The liquid medicine administration device 100 further includes the detector 160 detecting that the plunger 130 has advanced to the predetermined position L1, and the controller 170 that controls the start and stop of the operation of the drive mechanism 140. The controller 170 determines that a predetermined amount of the liquid medicine is not expelled from the liquid medicine container 110, when a predetermined time has elapsed after a command to start the operation is given to the drive mechanism 140, and the detector 160 does not detect that the plunger 130 has advanced to the predetermined position L1. Therefore, when blockage occurs in the liquid delivery path of the liquid medicine, the controller 170 can give a command to stop the operation of the drive mechanism 140 on the basis of the detection result by the detector 160. Thus, the configuration described above can prevent leakage of the liquid medicine when blockage occurs in the liquid delivery path of the liquid medicine.

[0055] While the liquid medicine administration device according to the present invention has been described above by way of the embodiment, the present invention is not limited to each of the described configurations, and can be appropriately modified on the basis of the description of the claims. In the following, a modification of the motor will be described. In the description of the modification, the description of the configuration and details of the liquid medicine administration system 1 described above will be appropriately omitted.

<First Modification>

[0056] A liquid medicine administration device 100 according to the first modification uses a DC motor as a motor 141A for the purpose of miniaturization and cost reduction in order to facilitate handling at the time of use and to save a storage space at the time of storage. The DC motor is a coreless motor which is easily downsized and has high torque efficiency with respect to electric power. The DC motor has a characteristic that a current supplied to the DC motor and the rotation speed of the DC motor are different depending on the magnitude of a load torque. The controller 170 detects an administration abnormality (a situation in which a predetermined amount of the liquid medicine is not expelled from the liquid medicine container 110) using the characteristics of the motor 141A. Therefore, a controller 170A controls the drive mechanism 140 as follows.

[0057] A specific operation of the controller 170A will be described with reference to Figs. 7A, 7B, and 8. Fig. 7A is a block diagram of a control system of the liquid medicine administration device 100 according to the first modification. Fig. 7B is a diagram schematically illustrating a rotation detector 161 and the like according to the first modification. Fig. 8 is a flowchart illustrating operation of the controller 170A according to the first modification.

[0058] As illustrated in Fig. 7A, the controller 170A is electrically connected to the motor 141A. A rotation shaft of the motor 141A is mechanically connected to the

speed reduction mechanism 142. In the speed reduction mechanism 142, an encoder 162 is provided as a rotation detector 161 that detects the rotation speed of the motor 141A.

[0059] As illustrated in Fig. 7B, the encoder 162 includes a photointerrupter 144 including an optical sensor, and a slit plate 145 having a large number of slits which are radially formed. The rotation of the motor 141A is detected by detecting whether or not light passes through the slits of the slit plate 145 with the optical sensor of the photointerrupter 144. The photointerrupter 144 is electrically connected to the controller 170A. In the present embodiment, the encoder 162 using the photointerrupter 144 is described as an example of the rotation detector 161, but an encoder using a magnetic sensor may be used.

[0060] When the controller 170A rotates the motor 141A, the speed reduction mechanism 142 is driven, so that the plunger 130 advances in the liquid medicine container 110 (see Fig. 4). At this time, the encoder 162 provided adjacent to the speed reduction mechanism 142 detects the rotation of the motor 141A, and the controller 170A calculates the rotation speed of the motor 141A on the basis of the rotation of the motor 141A detected by the encoder 162. The rotation of the motor 141A detected by the encoder 162 is fed back to the controller 170A, and the controller 170A calculates the rotation speed of the motor 141A or determines whether or not the motor 141A is rotating on the basis of the feedback result. Note that the rotation detector 161 can also be provided as a part of the speed reduction mechanism 142 Specifically, the slit plate 145 is eliminated, and instead, a large number of slits are radially provided in the gear of the speed reduction mechanism 142. The optical sensor of the photointerrupter 144 detects whether or not light passes through the slits provided in the gear, whereby the rotation of the motor 141A is detected. In this case, the encoder 162 is constituted by the gear of the speed reduction mechanism 142 and the photointerrupter 144. With this configuration, the liquid medicine with which the liquid medicine container 110 is filled is delivered to the lumen of the needle tube 220 via the liquid delivery path of the liquid medicine such as the tube 240 and the puncture portion 230, and is administered to the living body.

[0061] As illustrated in Fig. 8, the controller 170A activates the motor 141A at the time of administering the liquid medicine to the living body (S100), and determines whether or not the rotation speed of the motor 141A is higher than a predetermined rotation speed (S101). The rotation speed of the motor 141A at the time of administering the liquid medicine to the living body is set in advance according to the rate of administration of the liquid medicine. When the rotation speed of the motor 141A is lower than (not higher than) the predetermined rotation speed (S101: NO), it can be determined that the liquid medicine is normally administered, so that the administration of the liquid medicine is continued. On the other hand, when the rotation speed of the motor 141A is higher than the predetermined rotation speed (exceeds the predetermined rotation speed), it is considered that the plunger body 132 receives an axial reaction force equal to or greater than the pressing force from the gasket 135 due to an occurrence of an abnormality such as blockage of the liquid delivery path of the liquid medicine, resulting in that the transmission of the pressing force from the plunger 130 including the plunger body 132 to the gasket 135 is canceled by the canceling mechanism 10, and the load on the motor 141A is reduced (S101: YES). Therefore, the controller 170A detects an administration abnormality (S102). Next, the controller 170A stops the motor 141A (S103) and notifies the user of the administration abnormality (S104). The administration abnormality may be notified by lighting or blinking an LED provided on a case of the liquid medicine administration device 100, or by outputting a sound from a speaker provided inside the case of the liquid medicine administration device 100. In addition, the occurrence of the administration abnormality may be wirelessly reported to an external computer.

[0062] As described above, in the liquid medicine administration device 100 according to the first modification, the motor 141A is a DC motor. The liquid medicine administration device 100 further includes the rotation detector 161 that detects rotation of the DC motor and the controller 170A that controls rotation of the DC motor. The controller 170A stops the rotation of the motor 141A when the rotation speed of the motor 141A calculated based on the rotation of the motor 141A detected by the rotation detector 161 becomes equal to or higher than a predetermined speed. Therefore, in a case where blockage occurs in the liquid delivery path of the liquid medicine, the controller 170A can prevent the motor 141A from being continuously driven on the basis of the detection result of the detector 160. Thus, the configuration described above can prevent leakage of the liquid medicine when blockage occurs in the liquid delivery path of the liquid medicine.

[0063] While an example of the configuration of a medical device has been described above, the present invention is not limited to the description of the above embodiment, and various modifications are possible without departing from the gist of the present invention.

<Second Modification>

[0064] Next, modifications of the plunger and the canceling mechanism will be described by way of a second modification and a third modification. A liquid medicine administration device 100 according to the second modification includes a plunger 130A and a canceling mechanism 10A having structures different from those of the plunger 130 and the canceling mechanism 10 according to the above embodiment. Figs. 9A to 9C are diagrams for describing the plunger 130A and the canceling mechanism 10A according to the second modification.

[0065] The plunger 130A includes a plunger body 132A.

[0066] As illustrated in Figs. 9A to 9C, the plunger body 132A includes a base end portion 21 having a threaded portion 131, a tip portion 23 that is in contact with the gasket 135 (see Fig. 5), and an intermediate portion 22 formed between the base end portion 21 and the tip portion 23.

[0067] The canceling mechanism 10A has a thin portion 31 formed in the intermediate portion 22 of the plunger body 132A.

[0068] As illustrated in Figs. 9A and 9B, the plunger body 132A advances with the rotation of the feed screw 143 connected to the speed reduction mechanism 142, while rotation with respect to the housing 120 is being restricted by the rotation restriction unit 150.

[0069] When blockage occurs in the liquid delivery path of the liquid medicine, the thin portion 31 is bent or broken in a direction intersecting the direction in which the plunger body 132A advances. Note that Fig. 9C illustrates an example in which the thin portion 31 is broken in a direction intersecting the direction in which the plunger body 132A advances.

[0070] The state in which the thin portion 31 is bent means that, for example, when the plunger body 132A receives an axial reaction force equal to or greater than a preset pressing force from the gasket 135 (see Fig. 5), the plunger body 132A is bent at the thin portion 31 in a direction intersecting the axial direction, and the plunger body 132A is compressed and deformed in the axial direction, resulting in that the distance between the base end portion 21 and the tip portion 23 is decreased. In this case, the advancement of the tip portion 23 is stopped with respect to the base end portion 21 that continues to advance. Then, when the base end portion 21 of the plunger 130A continues to advance, the base end portion 21 is disengaged from the guide wall 152 of the rotation restriction unit 150 and turns free with respect to the housing 120. Therefore, the plunger 130A rotates together with the feed screw 143 without advancing. Accordingly, the canceling mechanism 10A (thin portion 31) can prevent the transmission of the pressing force from the plunger body 132A to the gasket 135.

[0071] The minimum thickness of the thin portion 31 is not particularly limited as long as it allows the thin portion 31 to be easily bent when blockage occurs in the liquid delivery path of the liquid medicine.

[0072] As described above, the plunger body 132A of the liquid medicine administration device 100 according to the second modification includes the base end portion 21 having the threaded portion 131, the tip portion 23 that is in contact with the gasket 135, and the intermediate portion 22 formed between the base end portion 21 and the tip portion 23. The canceling mechanism 10A has a thin portion 31 formed in the intermediate portion 22 of the plunger body 132A. When receiving the axial reaction force from the gasket 135, the thin portion 31 is bent or broken in a direction intersecting the direction in which the plunger body 132A advances. Therefore, the distance between the base end portion 21 and the tip portion 23 of the plunger body 132A is decreased due to the thin portion 31 being bent or broken, and the restriction of rotation of the plunger 130A with respect to the housing 120 by the rotation restriction unit 150 is removed. Thus, the advancement of the plunger body 132A with the rotation of the feed screw 143 is stopped.

[0073] According to the liquid medicine administration device 100 described above, when the plunger body 132A receives an axial reaction force from the gasket 135, the plunger body 132A is bent at the thin portion 31 in a direction intersecting the axial direction, and the advancement of the tip portion 23 is stopped with respect to the base end portion 21 that continues to advance. Then, the base end portion 21 is freed from the restriction of rotation by the rotation restriction unit 150. Therefore, the plunger 130A rotates together with the feed screw 143 without advancing. Accordingly, the canceling mechanism 10A including the thin portion 31 can prevent the transmission of the pressing force from the plunger body 132A to the gasket 135. Thus, the configuration described above can prevent leakage of the liquid medicine when blockage occurs in the liquid delivery path of the liquid medicine.

<Third Modification>

[0074] Next, a liquid medicine administration device 100 according to the third modification will be described with reference to Figs. 10A to 10C. The liquid medicine administration device 100 according to the third modification includes a plunger 130B and a canceling mechanism 10B having structures different from those of the plunger 130 and the canceling mechanism 10 according to the above embodiment. Figs. 10A to 10C are diagrams for describing the plunger 130B and the canceling mechanism 10B according to the third modification.

[0075] The plunger 130B includes a plunger body 132B. As illustrated in Figs. 10A to 10C, the plunger body 132B includes: an intermediate member 40 including the threaded portion 131 and a first protrusion 41; and a pressing member 50 including a second protrusion 51 and capable of pressing the gasket 135 (see Fig. 5).

[0076] The canceling mechanism 10B has the first protrusion 41 and the second protrusion 51.

[0077] As illustrated in Figs. 10A and 10B, when the first protrusion 41 of the intermediate member 40 and the second protrusion 51 of the pressing member 50 contact each other, the plunger body 132B advances with the rotation of the feed screw 143 connected to the speed reduction mechanism 142, while rotation with respect to the housing 120 is being restricted by the rotation restriction unit 150.

[0078] On the other hand, when blockage occurs in the liquid delivery path of the liquid medicine, the first protrusion 41 of the intermediate member 40 climbs over the second protrusion 51 of the pressing member 50 in the

direction in which the pressing member 50 advances as illustrated in Fig. 10C.

[0079] The state in which the first protrusion 41 climbs over the second protrusion 51 means that, for example, when the plunger body 132B receives an axial reaction force equal to or greater than a preset pressing force from the gasket 135 (see Fig. 5), the vicinity of the first protrusion 41 in the intermediate member 40 is bent in a radially inward direction intersecting the axial direction by the axial reaction force. In this case, the advancement of the pressing member 50 is stopped with respect to the intermediate member 40 that continues to advance. Then, when the intermediate member 40 of the plunger 130B continues to advance, the intermediate member 40 is disengaged from the guide wall 152 of the rotation restriction unit 150 and turns free with respect to the housing 120. Therefore, the plunger 130B rotates together with the feed screw 143 without advancing. Accordingly, the canceling mechanism 10B can prevent the transmission of the pressing force from the plunger body 132B to the gasket 135.

[0080] As described above, the plunger body 132B of the liquid medicine administration device 100 according to the third modification includes: the intermediate member 40 including the threaded portion 131 and the first protrusion 41; and the pressing member 50 including the second protrusion 51 contactable to the first protrusion 41 of the intermediate member 40 and capable of pressing the gasket 135. The canceling mechanism 10B has the first protrusion 41 of the intermediate member 40 and the second protrusion 51 of the pressing member 50. The plunger body 132B advances with the rotation of the feed screw 143 due to the contact between the first protrusion 41 of the intermediate member 40 and the second protrusion 51 of the pressing member 50, while rotation with respect to the housing 120 is being restricted by the rotation restriction unit 150. When the plunger body 132B receives the axial reaction force from the gasket 135, the first protrusion 41 of the intermediate member 40 climbs over the second protrusion 51 of the pressing member 50 in the direction in which the pressing member 50 advances, so that the contact between the first protrusion 41 of the intermediate member 40 and the second protrusion 51 of the pressing member 50 is released, and the advancement of the plunger body 132B with the rotation of the feed screw 143 is stopped.

[0081] According to the liquid medicine administration device 100, when the plunger body 132B receives the axial reaction force from the gasket 135, the vicinity of the first protrusion 41 in the intermediate member 40 is bent in a radially inward direction intersecting the axial direction by the axial reaction force, and the advancement of the pressing member 50 is stopped with respect to the intermediate member 40 that continues to advance. Then, the intermediate member 40 is freed from the restriction of rotation by the rotation restriction unit 150. Therefore, the plunger 130B rotates together with the feed screw 143 without advancing. Accordingly, the canceling mechanism 10B can prevent the transmission of the pressing force from the plunger body 132B to the gasket 135. Thus, the configuration described above can prevent leakage of the liquid medicine when blockage occurs in the liquid delivery path of the liquid medicine.

[0082] While the liquid medicine administration device according to the present invention has been described above by way of the modifications, the present invention is not limited to each of the described configurations, and can be appropriately modified on the basis of the description of the claims.

Reference Signs List

[0083]

1	liquid medicine administration system
10, 10A, 10B	canceling mechanism
21	base end portion
22	intermediate portion
23	tip portion
31	thin portion
40	intermediate member
41	first protrusion
50	pressing member
51	second protrusion
100	liquid medicine administration device
110	liquid medicine container
120	housing
122	chassis
130, 130A, 130B	plunger
131	threaded portion
132, 132A, 132B	plunger body
135	gasket
140	drive mechanism
141, 141A	motor
142	speed reduction mechanism
143	feed screw
144	photointerrupter
145	slit plate
150	rotation restriction unit
160	detector
161	rotation detector
162	encoder
170, 170A	controller
180	power supply unit
200	administration instrument
X	longitudinal direction
L1	predetermined position of plunger

Claims

1. A liquid medicine administration device (100) comprising:

a liquid medicine container (110) filled with a

liquid medicine and having, at a tip, an opening through which the liquid medicine is discharged;
a gasket (135) for expelling the liquid medicine in the liquid medicine container (110), the gasket (135) being slidable on an inner wall of the liquid medicine container (110);
a plunger (130, 130A, 130B) capable of pressing the gasket (135);
a housing (120) that holds the liquid medicine container (110) and the plunger (130, 130A, 130B);
a drive mechanism (140) that advances the plunger (130, 130A, 130B) toward the tip of the liquid medicine container (110); and
a rotation restriction unit (150) that restricts rotation of the plunger (130, 130A, 130B) with respect to the housing (120), wherein
the drive mechanism (140) includes a motor (141, 141A), and a feed screw (143) that rotates in response to the drive torque,
the plunger (130, 130A, 130B) has a threaded portion (131) threadedly engaged with the feed screw (143), and a plunger body (132, 132A, 132B) that advances with the rotation of the feed screw (143) and presses the gasket (135), while the rotation of the plunger (130, 130A, 130B) with respect to the housing (120) is being restricted by the rotation restriction unit (150),
characterized in that
the plunger (130, 130A, 130B) is provided with a canceling mechanism (10, 10A, 10B) that cancels transmission of a pressing force from the plunger body (132, 132A, 132B) to the gasket (135) when the plunger body (132, 132A, 132B) receives an axial reaction force equal to or greater than a preset pressing force from the gasket (135) during advancement with the rotation of the feed screw (143),

either
the canceling mechanism (10, 10A, 10B) includes the threaded portion (131), and
when the threaded portion (131) receives the axial reaction force from the gasket (135), the threaded portion (131) is worn by the feed screw (143), and the feed screw (143) turns free with respect to the threaded portion (131);
or
the plunger body (132, 132A, 132B) includes a base end portion (21) having the threaded portion (131), a tip portion (23) that is in contact with the gasket (135), and an intermediate portion (22) formed between the base end portion (21) and the tip portion (23),
the canceling mechanism (10, 10A, 10B) has a thin portion (31) formed in the intermediate portion (22) of the plunger body (132, 132A, 132B),
when receiving the axial reaction force from the gasket (135), the thin portion (31) is bent or broken in a direction intersecting a direction in which the plunger body (132, 132A, 132B) advances, and
due to the thin portion (31) being bent or broken, a distance between the base end portion (21) and the tip portion (23) of the plunger body (132, 132A, 132B) decreases, the restriction of rotation of the plunger (130, 130A, 130B) with respect to the housing (120) by the rotation restriction unit (150) is removed, and advancement of the plunger body (132, 132A, 132B) with the rotation of the feed screw (143) is stopped and the plunger rotates together with the feed screw;
or
the plunger body includes (132, 132A, 132B):

an intermediate member (40) including the threaded portion (131) and a first protrusion (41); and
a pressing member (50) that includes a second protrusion (51) contactable to the first protrusion (41) of the intermediate member (40) and that is capable of pressing the gasket (135),
the canceling mechanism (10, 10A, 10B) includes the first protrusion (41) of the intermediate member (40) and the second protrusion (51) of the pressing member (50),
the plunger body (132, 132A, 132B) advances with the rotation of the feed screw (143) due to contact between the first protrusion (41) of the intermediate member (40) and the second protrusion (51) of the pressing member (50), while the rotation of the plunger (130, 130A, 130B) with respect to the housing (120) is being restricted by the rotation restriction unit (150), and
when the plunger body (132, 132A, 132B) receives the axial reaction force from the gasket (135), the first protrusion (41) of the intermediate member (40) climbs over the second protrusion (51) of the pressing member (50) in a direction in which the pressing member (50) advances, so that the contact between the first protrusion (41) of the intermediate member (40) and the second protrusion (51) of the pressing member (50) is released, and the ad-

vancement of the plunger body (132, 132A, 132B) with the rotation of the feed screw (143) is stopped and the plunger rotates together with the feed screw.

2. The liquid medicine administration device (100) according to claim 1, further comprising:

a detector (160) configured to detect that the plunger (130, 130A, 130B) has advanced to a predetermined position; and
a controller (170, 170A) configured to control start and end of operation of the drive mechanism (140), wherein
the controller (170, 170A) determines that a predetermined amount of the liquid medicine has not been expelled from the liquid medicine container (110), when a predetermined time has elapsed after a command to start the operation is given to the drive mechanism (140) and when the detector (160) does not detect that the plunger (130, 130A, 130B) has advanced to the predetermined position.

3. The liquid medicine administration device (100) according to any one of claims 1 to 2, wherein

the motor (141, 141A) is a DC motor,
the liquid medicine administration device (100) further includes a rotation detector (161) that detects rotation of the DC motor, and a controller (170, 170A) that controls the rotation of the DC motor, and
the controller (170, 170A) stops the rotation of the DC motor when a rotation speed of the DC motor calculated based on the rotation of the DC motor detected by the rotation detector (161) becomes equal to or higher than a predetermined speed.

Patentansprüche

1. Vorrichtung (100) für die Verabreichung eines flüssigen Medikaments, umfassend:

einen Behälter (110) für flüssige Medikamente, der mit einem flüssigen Medikament gefüllt ist und an einer Spitze eine Öffnung aufweist, durch welche das flüssige Medikament abgegeben wird;
eine Dichtung (135) zum Ausstoßen des flüssigen Medikaments in dem Behälter (110) für flüssige Medikamente, wobei die Dichtung (135) auf einer Innenwand des Behälters (110) für flüssige Medikamente verschiebbar ist;
einen Kolben (130, 130A, 130B), der in der Lage ist, die Dichtung (135) zu drücken;
ein Gehäuse (120), das den Behälter (110) für flüssige Medikamente und den Kolben (130, 130A, 130B) aufnimmt;
einen Antriebsmechanismus (140), der den Kolben (130, 130A, 130B) in Richtung der Spitze des Behälters (110) für flüssige Medikamente vorschiebt; und
eine Drehungs-Beschränkungseinheit (150), welche die Drehung des Kolbens (130, 130A, 130B) in Bezug auf das Gehäuse (120) beschränkt, wobei
der Antriebsmechanismus (140) einen Motor (141, 141A) und eine Vorschubschraube (143) umfasst, die sich in Reaktion auf das Antriebsmoment dreht,
der Kolben (130, 130A, 130B) einen Gewindeabschnitt (131), der mit der Vorschubschraube (143) in Gewindeeingriff steht, und einen Kolbenkörper (132, 132A, 132B) aufweist, der sich mit der Drehung der Vorschubschraube (143) vorwärts bewegt und auf die Dichtung (135) drückt, während die Drehung des Kolbens (130, 130A, 130B) in Bezug auf das Gehäuse (120) durch die Drehungs-Beschränkungseinheit (150) beschränkt wird,
dadurch gekennzeichnet, dass
der Kolben (130, 130A, 130B) mit einem Aufhebungsmechanismus (10, 10A, 10B) versehen ist, der die Übertragung einer Druckkraft von dem Kolbenkörper (132, 132A, 132B) auf die Dichtung (135) aufhebt, wenn der Kolbenkörper (132, 132A, 132B) eine axiale Reaktionskraft erhält, die gleich oder größer ist als eine voreingestellte Druckkraft von der Dichtung (135) während der Vorwärtsbewegung mit der Drehung der Vorschubschraube (143),
wobei entweder
der Aufhebungsmechanismus (10, 10A, 10B) den Gewindeabschnitt (131) umfasst, und
wenn der Gewindeabschnitt (131) die axiale Reaktionskraft von der Dichtung (135) erhält, wird der Gewindeabschnitt (131) von der Vorschubschraube (143) verschlissen, und die Vorschubschraube (143) dreht sich frei in Bezug auf den Gewindeabschnitt (131);
oder
der Kolbenkörper (132, 132A, 132B) einen Basisendabschnitt (21), welcher den Gewindeabschnitt (131) aufweist, einen Spitzenabschnitt (23), der in Kontakt mit der Dichtung (135) ist, und einen Zwischenabschnitt (22), der zwischen dem Basisendabschnitt (21) und dem Spitzenabschnitt (23) ausgebildet ist, umfasst,
der Aufhebungsmechanismus (10, 10A, 10B) einen dünnen Abschnitt (31) aufweist, der in dem Zwischenabschnitt (22) des Kolbenkörpers (132, 132A, 132B) ausgebildet ist,

wenn die axiale Reaktionskraft von der Dichtung (135) erhalten wird, der dünne Abschnitt (31) in einer Richtung gebogen oder gebrochen wird, die sich mit einer Richtung schneidet, in der sich der Kolbenkörper (132, 132A, 132B) vorwärtsbewegt, und
dadurch, dass der dünne Abschnitt (31) gebogen oder gebrochen wird, ein Abstand zwischen dem Basisendabschnitt (21) und dem Spitzenabschnitt (23) des Kolbenkörpers (132, 132A, 132B) abnimmt, die Beschränkung der Drehung des Kolbens (130, 130A, 130B) in Bezug auf das Gehäuse (120) durch die Drehungs-Beschränkungseinheit (150) aufgehoben wird und die Vorwärtsbewegung des Kolbenkörpers (132, 132A, 132B) mit der Drehung der Vorschubschraube (143) gestoppt wird und der Kolben sich zusammen mit der Vorschubschraube dreht;
oder
der Kolbenkörper (132, 132A, 132B) umfasst:

ein Zwischenelement (40), das den Gewindeabschnitt (131) und einen ersten Vorsprung (41) umfasst; und
ein Druckelement (50), das einen zweiten Vorsprung (51) aufweist, der mit dem ersten Vorsprung (41) des Zwischenelements (40) in Kontakt gebracht werden kann, und das in der Lage ist, die Dichtung (135) zu drücken, der Aufhebungsmechanismus (10, 10A, 10B) den ersten Vorsprung (41) des Zwischenelements (40) und den zweiten Vorsprung (51) des Druckelements (50) umfasst,
der Kolbenkörper (132, 132A, 132B) sich mit der Drehung der Vorschubschraube (143) aufgrund des Kontakts zwischen dem ersten Vorsprung (41) des Zwischenelements (40) und dem zweiten Vorsprung (51) des Druckelements (50) vorwärts bewegt, während die Drehung des Kolbens (130, 130A, 130B) in Bezug auf das Gehäuse (120) durch die Drehungs-Begrenzungseinheit (150) begrenzt wird, und
wenn der Kolbenkörper (132, 132A, 132B) die axiale Reaktionskraft von der Dichtung (135) erhält, der erste Vorsprung (41) des Zwischenelements (40) über den zweiten Vorsprung (51) des Druckelements (50) in einer Richtung hinweg steigt, in der sich das Druckelement (50) vorwärts bewegt, sodass der Kontakt zwischen dem ersten Vorsprung (41) des Zwischenelements (40) und dem zweiten Vorsprung (51) des Druckelements (50) gelöst wird und die Vorwärtsbewegung des Kolbenkörpers (132, 132A, 132B) mit der Drehung der Vorschubschraube (143) gestoppt wird und der Kolben sich zusammen mit der Vorschubschraube dreht.

2. Vorrichtung (100) zur Verabreichung von flüssigen Medikamenten nach Anspruch 1, ferner umfassend:

einen Detektor (160), der so konfiguriert ist, dass er erfasst, dass der Kolben (130, 130A, 130B) in eine vorbestimmte Position vorgerückt ist; und
eine Steuerungseinrichtung(170, 170A), die so konfiguriert ist, dass sie den Beginn und das Ende des Betriebs des Antriebsmechanismus (140) steuert, wobei
die Steuerungseinrichtung (170, 170A) bestimmt, dass eine vorbestimmte Menge des flüssigen Medikaments nicht aus dem Behälter (110) für flüssige Medikamente ausgestoßen wurde, wenn eine vorbestimmte Zeit verstrichen ist, nachdem ein Befehl zum Starten des Betriebs an den Antriebsmechanismus (140) gegeben wurde, und wenn der Detektor (160) nicht erfasst, dass der Kolben (130, 130A, 130B) in die vorbestimmte Position vorgerückt ist.

3. Vorrichtung (100) zur Verabreichung von flüssigen Medikamenten nach einem der Ansprüche 1 bis 2, wobei

der Motor (141, 141A) ein Gleichstrommotor ist, die Vorrichtung (100) für die Verabreichung von flüssigen Medikamenten ferner einen Drehungsdetektor (161), der die Drehung des Gleichstrommotors erfasst, und eine Steuerungseinrichtung (170, 170A), welche die Drehung des Gleichstrommotors steuert, umfasst, und
die Steuerungseinrichtung (170, 170A) die Drehung des Gleichstrommotors stoppt, wenn eine Drehgeschwindigkeit des Gleichstrommotors, die auf der Grundlage der durch den Drehungsdetektor (161) erfassten Drehung des Gleichstrommotors berechnet wird, gleich oder höher als eine vorbestimmte Geschwindigkeit wird.

Revendications

1. Dispositif d'administration de médicament liquide (100) comprenant :

un contenant de médicament liquide (110) rempli d'un médicament liquide et présentant, au niveau d'une pointe, une ouverture à travers laquelle est distribué le médicament liquide ;
un joint d'étanchéité (135) pour expulser le médicament liquide dans le contenant de médica-

ment liquide (110), le joint d'étanchéité (135) pouvant coulisser sur une paroi interne du contenant de médicament liquide (110) ;
un piston (130, 130A, 130B) apte à appuyer sur le joint d'étanchéité (135) ;
un boîtier (120) qui renferme le contenant de médicament liquide (110) et le piston (130, 130A, 130B) ;
un mécanisme d'entraînement (140) qui fait avancer le piston (130, 130A, 130B) vers la pointe du contenant de médicament liquide (110) ; et
une unité de limitation de rotation (150) qui limite la rotation du piston (130, 130A, 130B) par rapport au boîtier (120), dans lequel
le mécanisme d'entraînement (140) comporte un moteur (141, 141A), et une vis sans fin (143) qui tourne en réponse au couple d'entraînement,
le piston (130, 130A, 130B) présente une partie filetée (131) en prise par filetage avec la vis sans fin (143), et un corps de piston (132, 132A, 132B) qui avance avec la rotation de la vis sans fin (143) et appuie sur le joint d'étanchéité (135),
en même temps que la rotation du piston (130, 130A, 130B) par rapport au boîtier (120) est limitée par l'unité de limitation de rotation (150),
caractérisé en ce que
le piston (130, 130A, 130B) est muni d'un mécanisme d'annulation (10, 10A, 10B) qui annule la transmission d'une force de pression du corps de piston (132, 132A, 132B) au joint d'étanchéité (135) lorsque le corps de piston (132, 132A, 132B) reçoit une force de réaction axiale supérieure ou égale à une force de pression prédéfinie provenant du joint d'étanchéité (135) pendant l'avancement avec la rotation de la vis sans fin (143),
soit
le mécanisme d'annulation (10, 10A, 10B) comporte la partie filetée (131), et
lorsque la partie filetée (131) reçoit la force de réaction axiale du joint d'étanchéité (135), la partie filetée (131) est portée par la vis sans fin (143), et la vis sans fin (143) se libère de la partie filetée (131) par rotation ;
soit
le corps de piston (132, 132A, 132B) comporte une partie d'extrémité de base (21) présentant la partie filetée (131), une partie de pointe (23) qui est en contact avec le joint d'étanchéité (135), et une partie intermédiaire (22) formée entre la partie d'extrémité de base (21) et la partie de pointe (23),
le mécanisme d'annulation (10, 10A, 10B) présente une partie mince (31) formée dans la partie intermédiaire (22) du corps de piston (132, 132A, 132B),
lorsqu'elle reçoit la force de réaction axiale en provenance du joint d'étanchéité (135), la partie mince (31) se courbe ou se rompt dans une direction croisant une direction dans laquelle le corps de piston (132, 132A, 132B) avance, et en raison de la courbure ou de la rupture de la partie mince (31), une distance entre la partie d'extrémité de base (21) et la partie de pointe (23) du corps de piston (132, 132A, 132B) diminue, la limitation de rotation du piston (130, 130A, 130B) par rapport au boîtier (120) par l'unité de limitation de rotation (150) est supprimée, et l'avancement du corps de piston (132, 132A, 132B) avec la rotation de la vis sans fin (143) est arrêté et le piston tourne conjointement avec la vis sans fin ;
ou bien
le corps de piston (132, 132A, 132B) comporte :

un élément intermédiaire (40) comportant la partie filetée (131) et une première saillie (41) ; et
un élément de pression (50) qui comporte une seconde saillie (51) pouvant entrer en contact avec la première saillie (41) de l'élément intermédiaire (40) qui est apte à appuyer sur le joint d'étanchéité (135),
le mécanisme d'annulation (10, 10A, 10B) comporte la première saillie (41) de l'élément intermédiaire (40) et la seconde saillie (51) de l'élément de pression (50),
le corps de piston (132, 132A, 132B) avance avec la rotation de la vis sans fin (143) en raison du contact entre la première saillie (41) de l'élément intermédiaire (40) et la seconde saillie (51) de l'élément de pression (50), en même temps que la rotation du piston (130, 130A, 130B) par rapport au boîtier (120) est limitée par l'unité de limitation de rotation (150), et
lorsque le corps de piston (132, 132A, 132B) reçoit la force de réaction axiale en provenance du joint d'étanchéité (135), la première saillie (41) de l'élément intermédiaire (40) monte sur la seconde saillie (51) de l'élément de pression (50) dans une direction dans laquelle avance l'élément de pression (50), de sorte que le contact entre la première saillie (41) de l'élément intermédiaire (40) et la seconde saillie (51) de l'élément de pression (50) soit rompu, et l'avancement du corps de piston (132, 132A, 132B) avec la rotation de la vis sans fin (143) est arrêté et le piston tourne conjointement avec la vis sans fin.

2. Dispositif d'administration de médicament liquide (100) selon la revendication 1, comprenant en outre :

un détecteur (160) configuré pour détecter que le piston (130, 130A, 130B) a avancé jusqu'à une position prédéterminée ; et
un dispositif de commande (170, 170A) configuré pour commander le début et la fin d'une opération du mécanisme d'entraînement (140), dans lequel
le dispositif de commande (170, 170A) détermine qu'une quantité prédéterminée du médicament liquide n'a pas été expulsée du contenant de médicament liquide (110), lorsqu'un temps prédéterminé s'est écoulé après qu'une commande de démarrage de l'opération a été donnée au mécanisme d'entraînement (140) et lorsque le détecteur (160) ne détecte pas que le piston (130, 130A, 130B) a avancé jusqu'à la position prédéterminée.

3. Dispositif d'administration de médicament liquide (100) selon l'une quelconque des revendications 1 à 2, dans lequel

le moteur (141, 141A) est un moteur CC,
le dispositif d'administration de médicament liquide (100) comporte en outre un détecteur de rotation (161) qui détecte une rotation du moteur CC, et un dispositif de commande (170, 170A) qui commande la rotation du moteur CC, et
le dispositif de commande (170, 170A) arrête la rotation du moteur CC lorsqu'une vitesse de rotation du moteur CC, calculée sur la base de la rotation du moteur CC détectée par le détecteur de rotation (161), devient supérieure ou égale à une vitesse prédéterminée.

FIG. 1

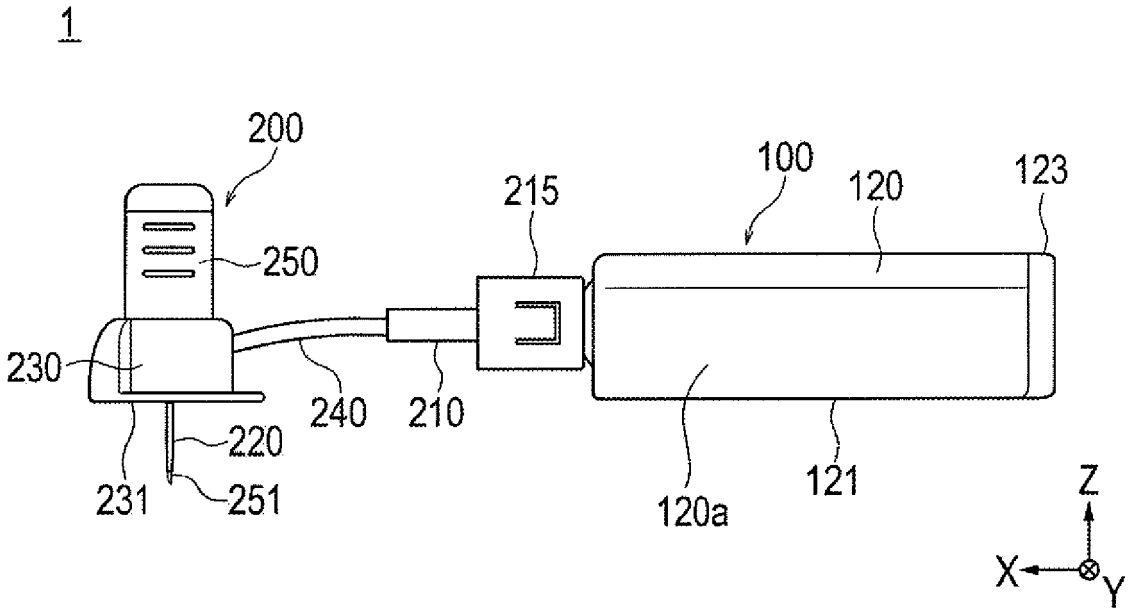

1
200
250
230
240
210
215
100
120
123
220
231
251
120a
121
Z
X
Y

FIG. 2

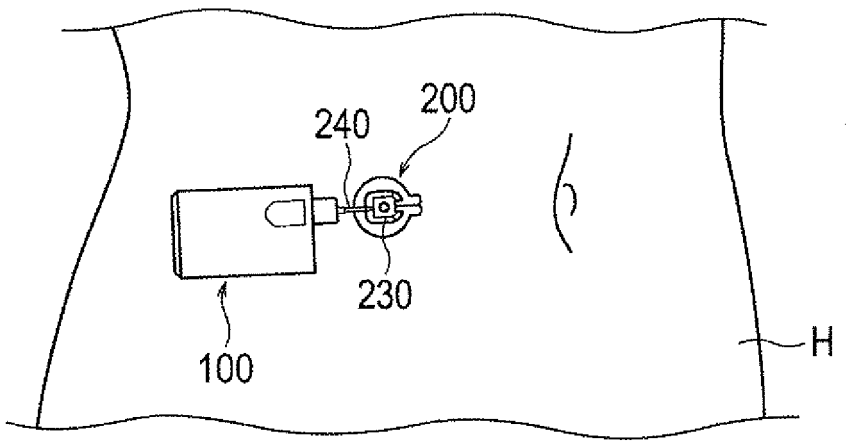

240
200
230
100
H

FIG. 3

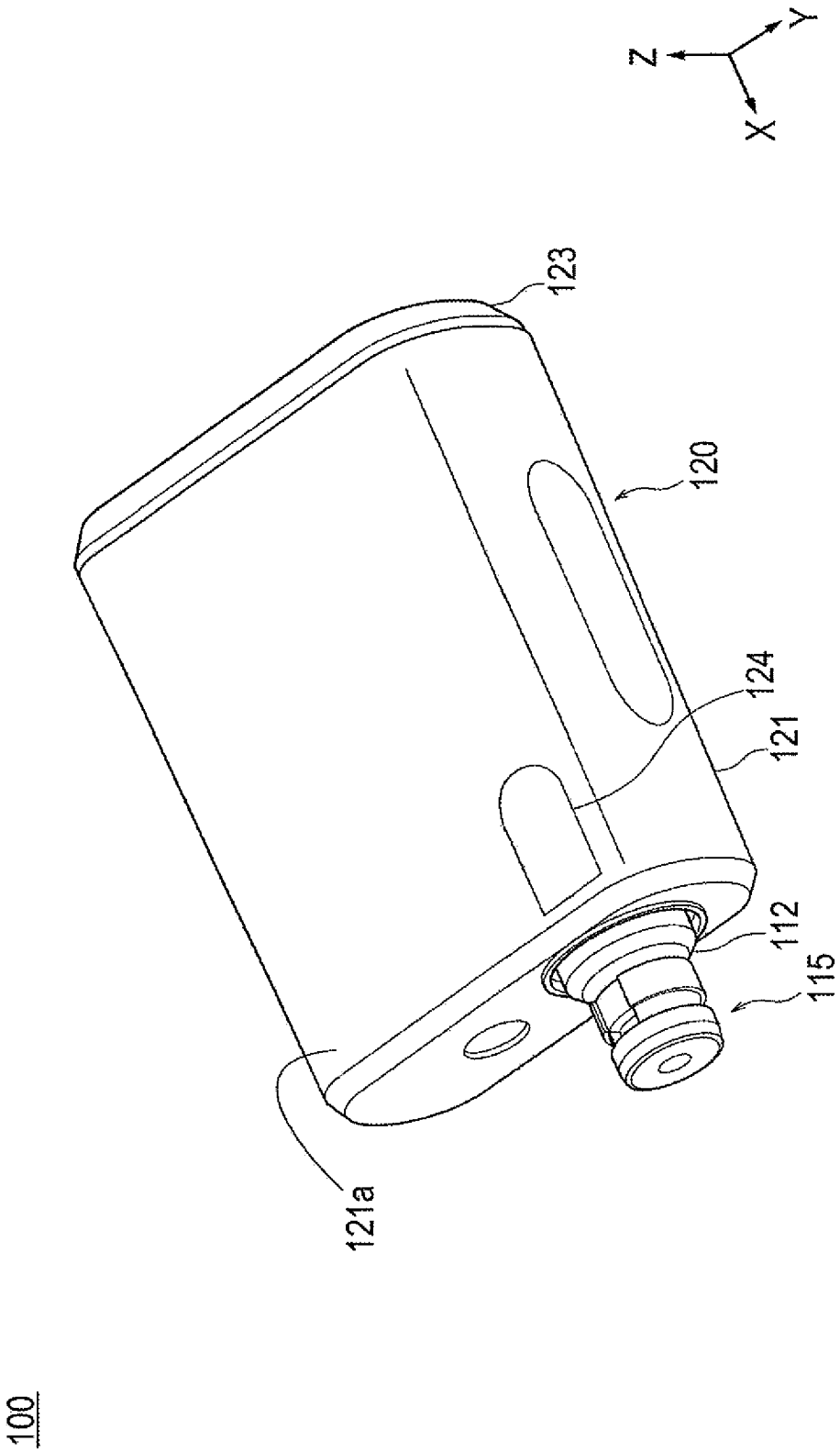


FIG. 4

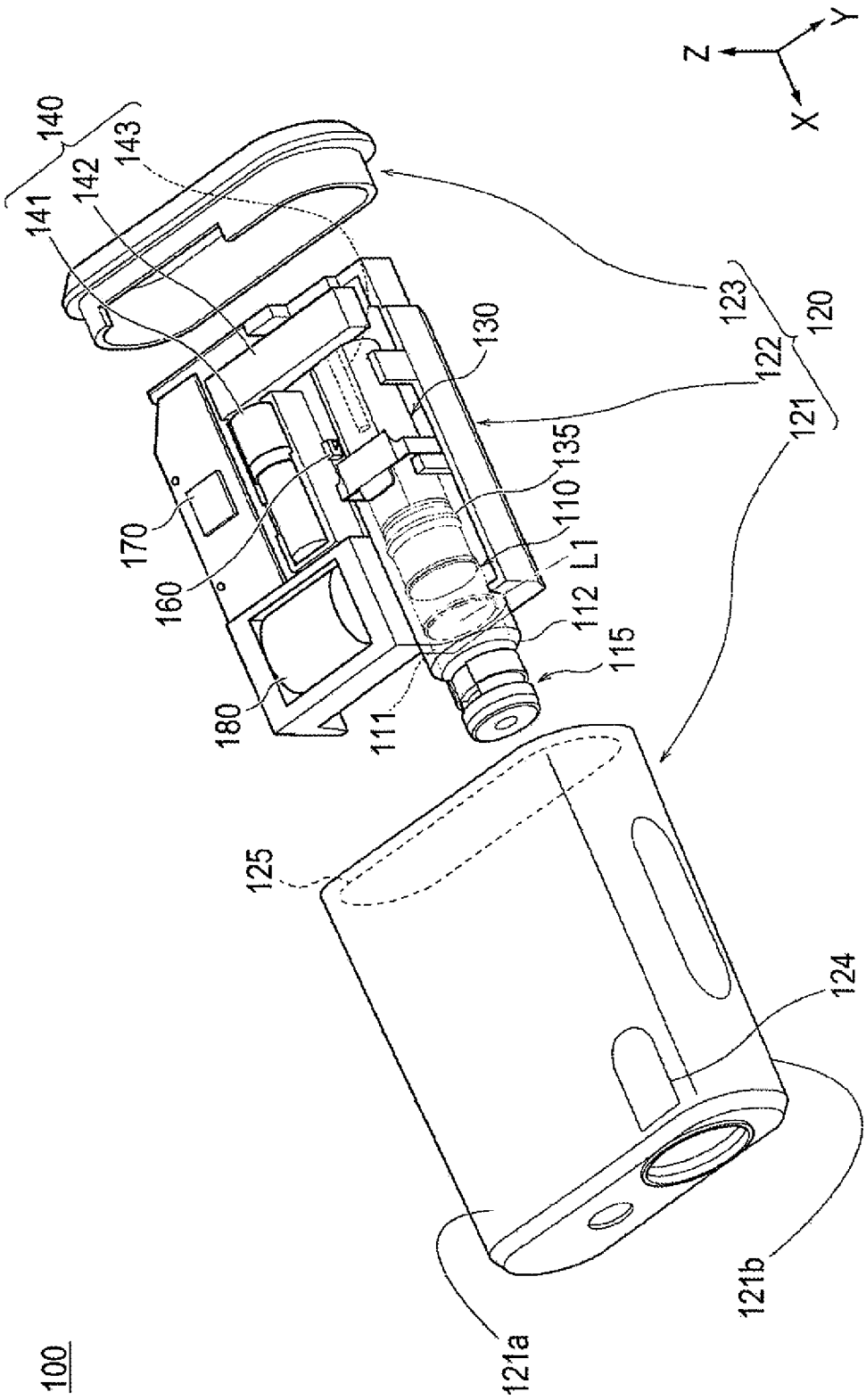

Z
Y
X
140
141
142
143
123
120
122
121
130
135
110
112
L1
115
170
160
180
111
125
124
121a
121b
100

FIG. 5

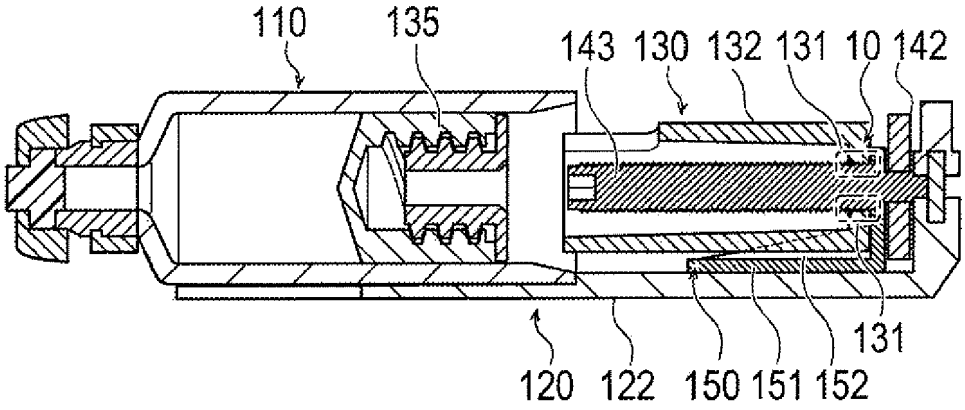

110
135
143
130
132
131
10
142
131
120
122
150
151
152

FIG. 6A

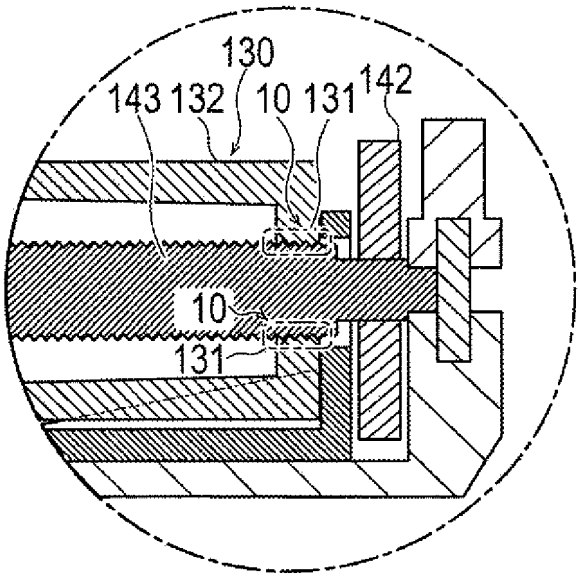

130
143
132
10
131
142
10
131

FIG. 6B

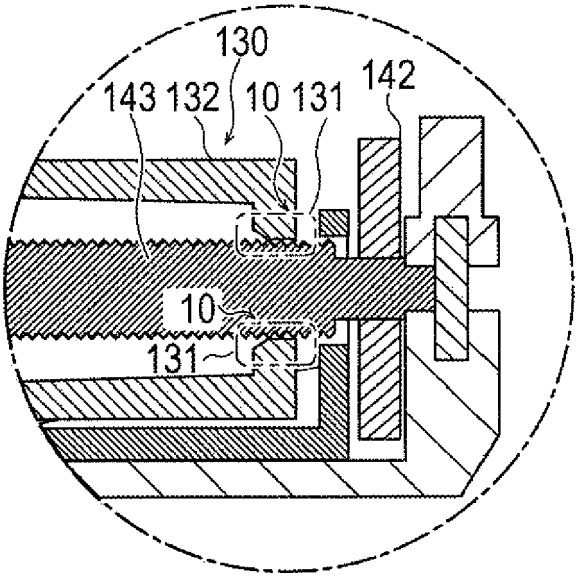


FIG. 7A

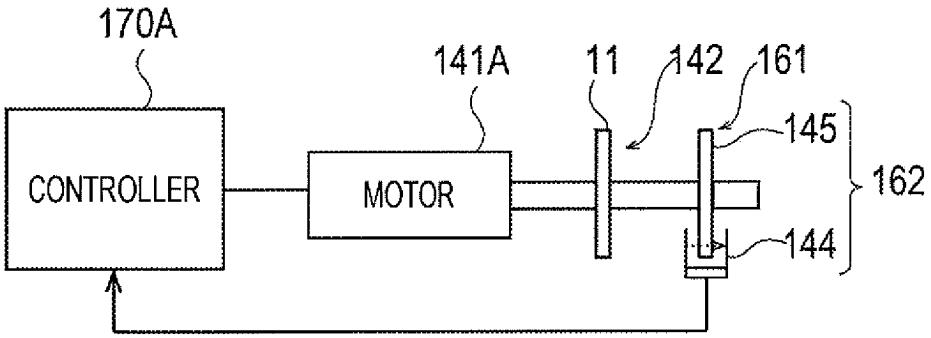

170A
CONTROLLER
MOTOR
141A
11
142
161
145
162
144

FIG. 7B

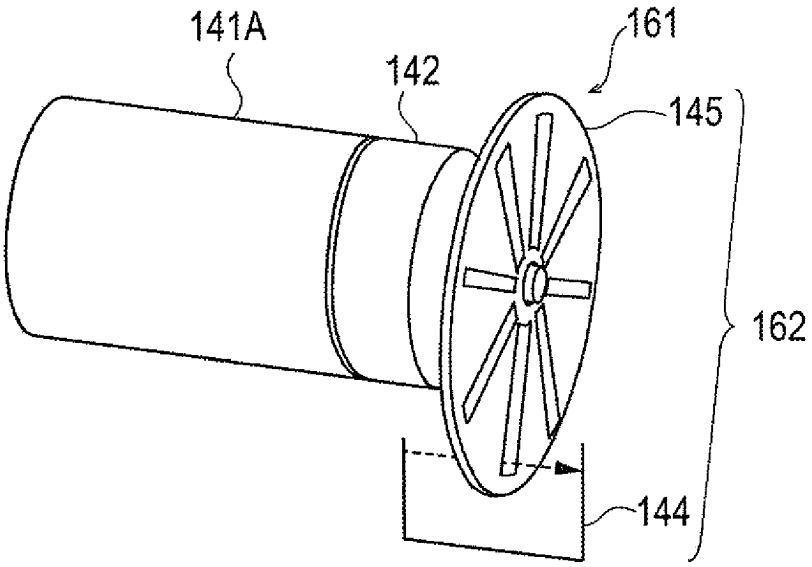

141A
142
161
145
162
144

FIG. 8

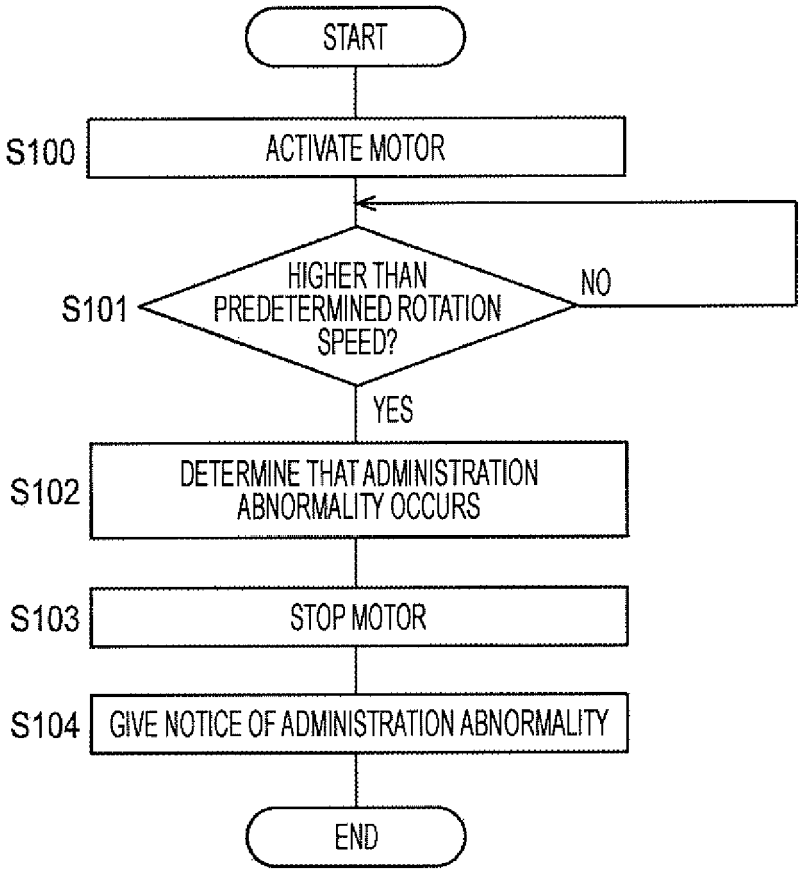

START
S100
ACTIVATE MOTOR
S101
HIGHER THAN PREDETERMINED ROTATION SPEED?
NO
YES
S102
DETERMINE THAT ADMINISTRATION ABNORMALITY OCCURS
S103
STOP MOTOR
S104
GIVE NOTICE OF ADMINISTRATION ABNORMALITY
END

FIG. 9A

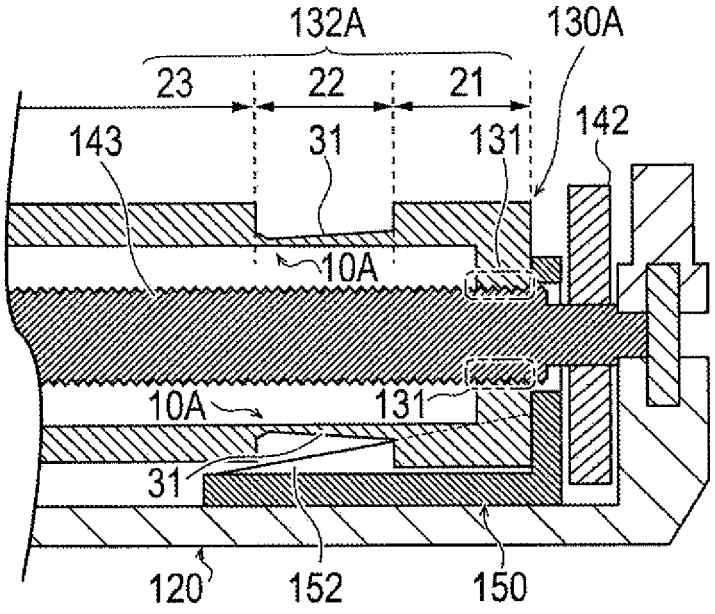

132A
130A
23
22
21
143
31
131
142
10A
10A
131
31
120
152
150

FIG. 9B

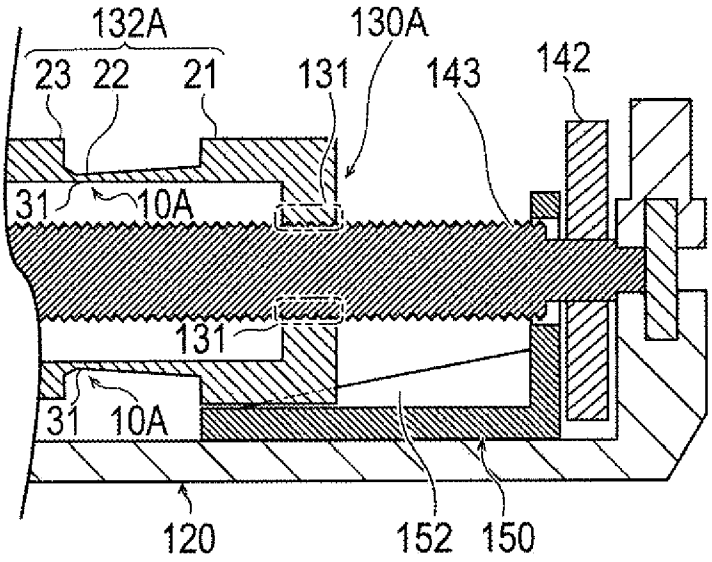

132A
130A
23
22
21
131
143
142
31
10A
131
31
10A
120
152
150

FIG. 9C

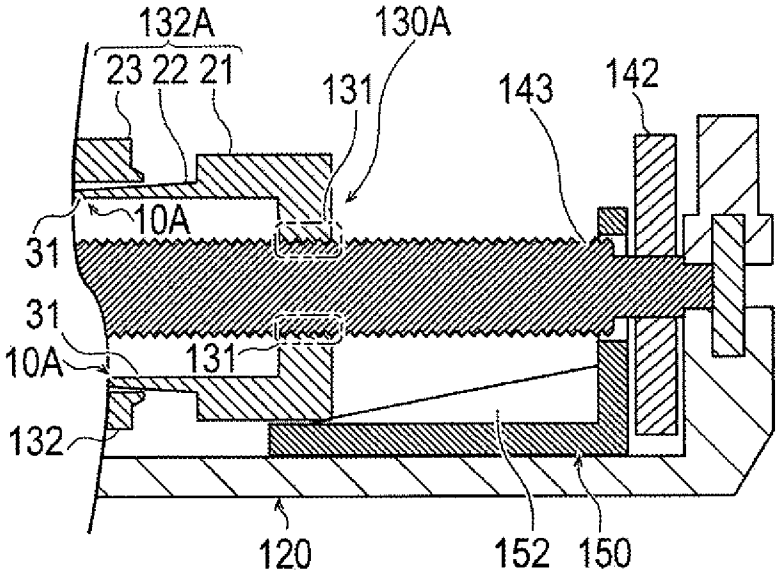

132A
130A
23
22
21
131
143
142
10A
31
31
10A
131
132
120
152
150

FIG. 10A

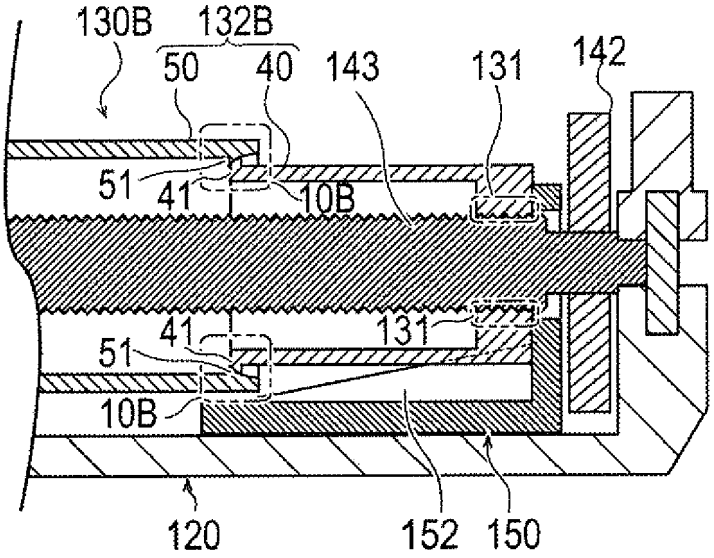


FIG. 10B

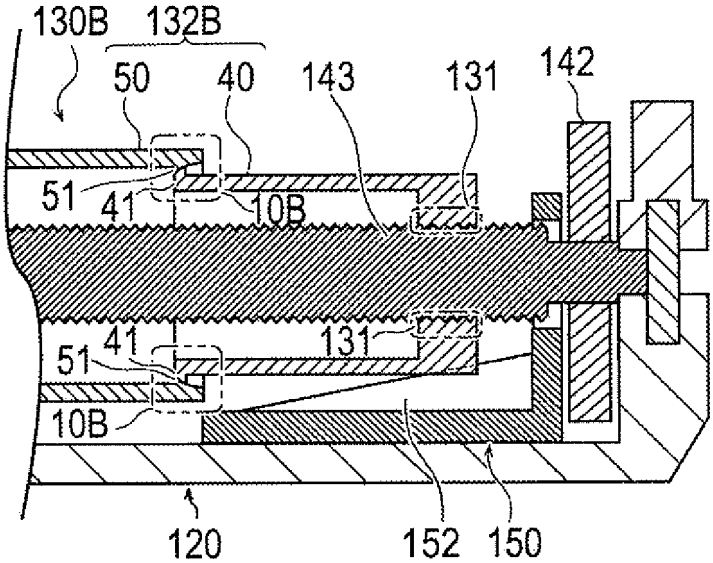
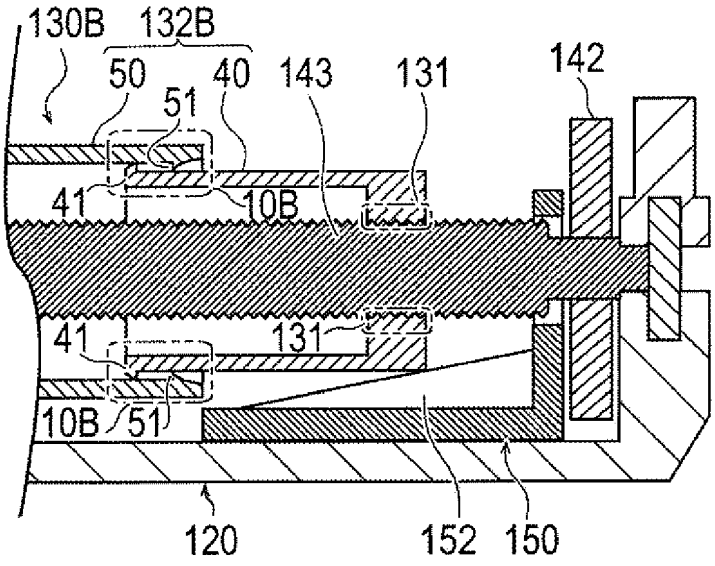


FIG. 10C



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Patent documents cited in the description

- JP 2015181835 A **[0004]**